Atomic and Nuclear States within the Dynamic Theory

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This presentation is intended to display the manner in which the Dynamic Theory addresses the atomic and nuclear states and provide a basis for interpreting the more difficult full investigation of states. The basis rests upon the Dynamic Theory's quantization of a gauge function, which yields quantization of electric charge and orbital like interaction of particles, and the premise that the functional form of the gauge function remain the same in the atomic and nuclear realm as it is in the cosmological, or red shift, realm.

Our starting point is the gauge function in the form determined by a study of red shifts, or

$$\ln f^{\frac{1}{2}} = mk(1-bt)\frac{e^{-\frac{\lambda}{r}}}{r}. \qquad (1)$$

The route to be taken toward evaluating the parameters of this gauge function includes looking at isentropic states in order to determine stable states. First, consider the quantum condition of the Dynamic Theory, which may be stated as

$$\int \phi_i dx^i = 2\pi N \quad (2)$$

where we shall first seek what gauge potentials are allowed for particles and then what paths are allowed for interacting particles.

The only non-zero gauge potentials, assuming spherical symmetry, become

$$\phi_0 = \frac{\partial \ln f^{\frac{1}{2}}}{\partial(ct)} = -\frac{N_0 kbm}{c}\frac{e^{-\frac{\lambda}{r}}}{r}$$

$$\phi_r = \frac{\partial \ln f^{\frac{1}{2}}}{\partial(r)} = -N_r km(1-bt)\left(1-\frac{\lambda}{r}\right)\frac{e^{-\frac{\lambda}{r}}}{r^2} \qquad (3)$$

$$\phi_4 = \frac{\partial \ln f^{\frac{1}{2}}}{\partial\left(\frac{Gm}{c^2}\right)} = N_4 k(1-bt)\frac{e^{-\frac{\lambda}{r}}}{r}.$$

where the N's are the gauge potential quantum numbers required by the quantum condition and are contained within the K.

The gauge fields may be obtained and checked within the eight field equations. We find that the
non-zero field equations are

$$E_r = \frac{\partial \phi_r}{\partial (ct)} - \frac{\partial \phi_0}{\partial (r)} = \frac{Z\eta kbm^2}{c}\left(1-\frac{\lambda}{r}\right)\frac{e^{-\frac{\lambda}{r}}}{r^2}$$

$$V_r = \frac{\partial \phi_r}{\partial \left(\frac{Gm}{c^2}\right)} - \frac{\partial \phi_4}{\partial (r)} = \frac{Z\beta\eta km}{\frac{G}{c^2}}\left(1-\frac{\lambda}{r}\right)\frac{e^{-\frac{\lambda}{r}}}{r^2} \quad (4)$$

where the and are included in order to obtain the correct units and Z is the difference in the gauge potential quantum numbers is the charge to mass ratio required by the Dynamic Theory and is yet to be determined. The appearance of the additional mass term in the fields is due to the fact that, within the Dynamic Theory the fields equations are field densities, which is consistent with the entropy being an extensive quantity.

When the gauge fields are put into the field equations one finds that the electric charge is given by

$$q \equiv Ze = \frac{Z\varepsilon_0 \eta kbm^2}{c}. \quad (5)$$

While the gravitating mass is found to be

$$M = \frac{\varepsilon_0 Z\eta km}{\beta\left(\frac{G}{c^2}\right)}(1-bt). \quad (6)$$

From Equations (4) and (5) one may notice that the electric charge is not a primitive quantity and that the gravitating mass is time dependent, just as the Dynamic Theory requires.

Forces

Comparison of the above fields and charges with the forces of interaction is a way in which the above may be checked against experiment. In particular, the atomic energy states are an attractive means of comparing with experiment since the atomic energy states determine the experimental frequencies seen from stimulated atoms.

From the force law, which multiplies a charge times a field, one finds that the electric force between two particles is given as

$$F_{e12} = q_1 E_{r2} = \frac{Z_1 Z_2 e_1 e_2}{4\pi\varepsilon_0}\left(1-\frac{\lambda_2}{r}\right)\frac{e^{-\frac{\lambda_2}{r}}}{r^2} \quad (7)$$

where we have not imposed the requirement that unit of electric charge be the same for all particles yet. We note also that should the separation, *r*, be significantly greater than the of the particle the radial dependence approximates that of classical electric forces.

The Dynamic Theory gives the gravitational force as

$$F_{g12} = M_1 V_{r2} = Z_1 Z_2 G M_1 M_2 \left(1 - \frac{\lambda}{r}\right) \frac{e^{-\frac{\lambda}{r}}}{r^2} \qquad (8)$$

when Equation (6) is used and it is given that the Dynamic Theory gives

$$\beta \equiv \sqrt{\varepsilon_0 G}, \qquad (9)$$

as the charge to mass ratio. This also looks to have a form comparable with the classical case.

Isentropic Interactions Between Particles

To investigate the isentropic interaction of two particles the Dynamic Theory tells us to look at isolated systems where the entropy is constant. In this case the quantum condition of Equation (2) must hold even if knowing the particles involved provides us with knowledge of the gauge potentials. What remains then is ask what paths are possible given the gauge potentials are known and the quantum condition must be satisfied. While recognizing that paths are possible where *dr* is non-zero, suppose one considers circular motion for which $dr = 0$. This is an allowed path and represents those chosen by Bohr in his first cut at atomic theory.

The full five dimensionality of the Dynamic Theory requires us to comment on the fourth component of the gauge potential. For the moment we shall consider that dm = 0 in our quantum condition. We shall return to the non-zero condition later.

From Equations (2) and (3) we find that

$$\int \phi_0 d(ct) = 2\pi N = -N_0 (kbm)_p \frac{e^{-\frac{\lambda}{r}}}{r} cT. \qquad (10)$$

In Equation (10) we note that the N is the orbital quantum number while the gauge potential quantum number also appears explicitly. Also, it should be noted that the subscript, *p*, denotes the fact that the coefficient of time in the gauge function may be specific to the particle.

Now one may use the equilibration between the force of attraction between the particles and the centripetal acceleration to arrive at an expression for the velocity in the circular orbit of

$$v = \sqrt{\frac{-Z_e Z_p e_e e_p}{4\pi\varepsilon_0 m_e r}} \qquad (11)$$

where the unit of charge has not yet been equated and the separation is taken to be large with respect to lambda. Using the relation between the period, radius and velocity of circular motion, we may find that the radius is given by

$$r = \frac{N^2 (-Z_e Z_p e_e e_p)}{N_0^2 (kbm)_p^2 4\pi\varepsilon_0 m_e}. \qquad (12)$$

One may now use the definition of angular momentum and Equations (11) and (12) to arrive at

$$L = m_e vr = \sqrt{\frac{-Z_e Z_p e_e e_p m_e r}{4\pi\varepsilon_0}} = \frac{N_\hbar}{N_0} \quad (13)$$

where

$$\hbar \equiv \frac{-Z_e Z_p e_e e_p}{4\pi\varepsilon_0 (kbm)_p}. \qquad (14)$$

We find that the unit of angular momentum in the interaction between the electron and proton is not a primitive number itself. Rather it depends upon the unit of charge and the coefficient of time in the gauge function of the proton. However, should one take into account the definitions of the particles' charges as given by Equation (5), they find that the unit of angular momentum depends upon the mass of both particles and the coefficient of time of the gauge function of the electron. To see this we should attempt to evaluate these coefficients.

We may use the potential and kinetic energy expressions in the same manner as is done in classical physics to arrive at the expression for the energy states. These will also be the entropy states since the energy and entropy differ by the Lorentz contraction factor and for these low velocity this becomes unity. The entropy states are thus given by

$$\begin{aligned} E &= \frac{-m_e Z_e^2 Z_p^2 e_e^2 e_p^2}{2(4\pi\varepsilon_0)^2 \hbar^2 \left(\frac{N^2}{N_0^2}\right)} \\ &= \frac{-m_e (kbm)_p^2}{2\left(\frac{N^2}{N_0^2}\right)} \end{aligned} \qquad (15)$$

where the last expression is obtained by using the definition for the unit of angular momentum, Equation (14).

Note that the entropy states are determined by the mass of the orbiting particle, the coefficient of time in the gauge function of the field particle, the quantum number of the orbit and the quantum number of the electrostatic gauge potential of the field particle. The experimental evidence of these entropy states as given by the frequencies of excited atoms will determine the value of the coefficient of time in the proton gauge function. All other parameters, such as the unit of electric charge and the unit of angular momentum may then be determined from this value.

The picture of the entropy states may be further illuminated when one uses the determination of k from the red shift data. From red shift data the Dynamic Theory requires that

$$k = -\frac{G}{c^2} \qquad (16)$$

so the expression for the entropy states may be written as

$$E = \frac{-m_e G^2 m_p^2 b_p^2}{2c^2\left(\frac{N^2}{N_0^2}\right)}. \qquad (17)$$

From this it may be seen that the only parameter to be evaluated from experimental frequencies is
the *b* itself.

Looking back at Equation (7) one sees that the force between the particles goes to zero when the separation equals lambda and then changes sign as the separation decreases further. This sets up additional possible circular orbits in which protons may orbit around electrons. We have developed the tools to quickly look at this case as well.

If one supposes that a proton is in orbit around an electron at separation of the lambda of the proton the separation is still much greater than the lambda of the electron and therefore, our previous assumptions which allowed the dropping of the exponential term hold in this case also. However, in using this case and the simplicity of the previous development of the atomic circular orbits we are ignoring the fact that in these tight orbits of protons around electrons the velocities are becoming relativistic. Since we wish to use the example as illustrative instead of exact quantitatively, we shall accept the errors the approximation introduces.

The proton is now the particle in motion so that its velocity may be given by Equation (11) replacing the mass of the electron with the mass of the proton. Similarity, Equation (12) specifies the radius of the proton when the roles of the electron and proton are reversed. The same is true of the expression for the angular momentum, so that the unit of angular momentum for this case must be given by

$$\hbar_e \equiv \frac{-Z_e Z_p e_e e_p}{4\pi\varepsilon_0 (kbm)_e} \qquad (18)$$

which has the same form as before, but different value.

In this case, calculation of the potential entropy/energy may be seen to be

$$V = -\int_r^\infty \frac{Z_e Z_p e_e e_p}{4\pi\varepsilon_0 r^2}\,dr \quad (19)$$

which means that when one adds the kinetic energy to the potential energy of Equation (19) one obtains

$$E_n = \frac{3(kbm)_e m_p}{2\left(\frac{N^2}{N_0^2}\right)} \qquad (20)$$

which may easily be seen to be positive. The positive value of the entropy/energy levels means that this state will decay through the mechanism of quantum tunneling. Previously, this state has been seen to be best equated with the experimental data of the neutron. The arguments that might be envisioned with regard to the unit of action may be answered by considering the difference between Equations (14) and (18).

Previously we did not follow up on the consequences of requiring the unit of electric charge to be the same for each particle, however, if we now impose this requirement Equations (5), (14) and (18) require that

$$\hbar_e = \frac{m_e}{m_p}\hbar \qquad (21)$$

which is approximately the value determined previously.

Suppose we now go to another example still accepting the approximations of non-relativistic motion and circular orbits. For this case consider two protons in binary orbits where the reduced mass would be half the proton mass. Since the field particle carries the field of the proton the unit of angular momentum would be given by Equation (14) while the entropy states would be given by

$$E_{He} = \frac{-m_p \frac{N_0^2}{2}(kbm)_p^2}{2N^2} = \frac{1}{2}\left(\frac{m_p}{m_e}\right)E_a \approx -12.5KeV\left(\frac{N_0^2}{N^2}\right) \qquad (22)$$

which would suggest that any photons emitted as the result of transitions between these states would result in gamma emission.

Conclusions

1. Within the above one sees that there is only one primitive parameter in the entropy/energy levels of the atom. Should one choose the coefficient of time in the gauge function as the primitive one then both the unit of electric charge and the unit of angular momentum may be determined. Alternatively, when considering the example of the proton-proton interactions the requirement that the unit of electric charge be the same for both the electron and proton provides the right level of gamma emissions for transitions between these entropy states. Therefore, it may be desirable to consider the unit of electric charge as the primitive number and the coefficient of time in the gauge function and the unit of angular momentum as the derived quantities.

2. It may be noted that there is no requirement for the unit of electric charge to be the same for the electron and proton in order to predict the atomic entropy states.

3. The unit of angular momentum for atomic states is different from the unit of angular momentum of the neutron.

4. The lifetime of the neutron may be calculated using the relativistic solution to the proton orbiting around an electron to obtain the potential function needed for the tunneling calculations.

5. The proton-proton interactions display the right level of gamma emission for transitions between the excited nuclear entropy states.